



U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD for NuScale SMR DESIGN

5.2.4 REACTOR COOLANT PRESSURE BOUNDARY INSERVICE INSPECTION AND TESTING

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of component integrity issues related to reactor coolant pressure boundary

Secondary - Organization responsible for the review of probabilistic risk assessment (PRA), if a risk-informed inservice inspection ISI program is submitted.

I. AREAS OF REVIEW

Components that are part of the reactor coolant pressure boundary (RCPB) must be designed and provided with access to permit periodic inspection and testing of important areas and features to assess their structural and leaktight integrity. Inservice inspection (ISI) programs are based on the requirements of 10 CFR 50.55a, "Codes and Standards," in that Code Class 1 components, as defined in Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (hereinafter "the ASME Code"), meet the applicable inspection requirements set forth in ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components." Inservice inspection includes a pre-service examination prior to initial plant startup as required by subarticle NB-5280 of ASME Section III, Division 1, "Rules for Construction of Nuclear Facility Components."

This Design Specific Review Standard (DSRS) does not address those unique aspects of the NuScale design that may limit the effective use of ASME Section XI, to ensure the safe operation of the plant. These unique aspects will be addressed by the applicant and reviewed by the staff on a case-by-case basis. When innovative designs are applied to ASME code components, it is the responsibility of the applicant to assure that the corresponding ASME Section XI inspection requirements are evaluated for sufficiency and supplemented as necessary to ensure that structural and leak-tight integrity is maintained. The applicant should also assure that all SSCs that require inservice inspection, including those that are not addressed in ASME Section XI, are appropriately inspected and tested commensurate with the importance of the safety functions to be performed

The specific areas of review are as follows:

1. System Boundary Subject to Inspection. The ISI program for those portions of the RCPB consisting of Code Class 1 components, other than steam generator tubes, is reviewed.
2. Accessibility. The descriptive information that pertains to the general and specific provisions for access to components covered by the ASME Section XI, is reviewed. In

addition, the remote access equipment needed to perform inspections in a radiation field or areas not readily accessible to inspection personnel is reviewed.

3. Examination Categories and Methods. The descriptive information that pertains to ASME Section XI, Subsection IWA, "General Requirements," and Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Power Plants," is reviewed.
4. Inspection Intervals. The schedules of examinations, inspections, and tests in the applicant's or licensee's safety analysis report (SAR) and plant Technical Specifications are reviewed. In addition, those inspections and tests which are performed during the inspection interval, such as during refueling outages, are reviewed.
5. Evaluation of Examination Results
 - A. The proposed evaluation methods for any flaws detected during ISI examinations are reviewed.
 - B. The repair procedures proposed for components that reveal defects during ISI examinations are reviewed.
6. System Pressure Tests. The descriptive information on system pressure tests of Code Class 1 components is reviewed.
7. Code Exemptions. The ASME Section XI Code exemptions as permitted by ASME Section XI, Subsubarticle IWB-1220, "Components Exempt from Examination," are reviewed.
8. Relief Requests. Relief requests intended to be used are reviewed.
9. Code Cases. ASME Code Cases referenced in Regulatory Guide (RG) 1.147 that may have been invoked in connection with the ISI programs are reviewed. Code cases not referenced in RG 1.147 will be reviewed on a case-by-case basis.
10. Augmented ISI to Protect Against Postulated Piping Failures. The augmented ISI Program to protect against postulated failures of the high-energy fluid system piping between containment isolation valves is reviewed.
11. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed inspections, tests, analyses, and acceptance criteria (ITAAC) associated with the structures, systems, and components (SSCs) related to this DSRS section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this DSRS section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

12. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

13. Operational Program Description and Implementation. For a COL application, the staff reviews the Preservice Inspection (PSI), and ISI Program descriptions and the proposed implementation milestones. The staff also reviews final safety analysis report (FSAR) Table [13.4-x] to ensure that the PSI/ISI Programs and associated milestones are included.
14. Risk-Informed ISI Programs. Risk informed ISI programs may be submitted for NRC staff review and authorization as an alternative to the regulations pursuant to 10 CFR § 50.55a(a)(3). The risk informed program is reviewed to verify that the applicant or licensee has demonstrated that either the program provides an acceptable level of quality and safety or that compliance with the current regulations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Review Interfaces

Other DSRS sections interface with this section as follows:

1. The ISI requirements for ASME Code Class 2 and 3 components, reactor containment, and high-energy fluid system piping between containment isolation valves are reviewed under DSRS Section 6.6, "Inservice Inspection and Testing of Class 2 and 3 Components."
2. The structural integrity of pressure-retaining components, their supports, and core support structures are reviewed under SRP Section 3.9.3, "ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures."
3. The program for assuring the integrity of bolting and threaded fasteners is reviewed under SRP Section 3.13, "Threaded Fasteners - ASME Code Class 1, 2, and 3."
4. The reactor vessel material surveillance program is reviewed under DSRS Sections 5.3.1, "Reactor Vessel Materials" and 5.3.3, "Reactor Vessel Integrity."
5. The ISI requirements for steam generator tube inspection are reviewed under DSRS Section 5.4.2.2, "Steam Generator Program."
6. Verification that systems and components are appropriately classified in accordance with regulatory requirements and NRC quality group classification guidance, including verification that Quality Group A, B, and C components meet the requirements for Code Class 1, 2, and 3 components is performed under SRP Sections 3.2.2, "System Quality

Group Classification” and 5.2.1.1, “Compliance with the Codes and Standards Rule, 10 CFR 50.55a.”

7. Verification of the acceptability of any ASME Code Cases that the applicant may have invoked in connection with the ISI program is performed under SRP Section 5.2.1.2, “Applicable Code Cases.”
8. For COL reviews of operational programs, the review of the applicant’s implementation plan is performed under SRP Section 13.4, “Operational Programs.”

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. General Design Criteria (GDC) 32 found in Appendix A to 10 CFR Part 50, as it relates to periodic inspection and testing of the RCPB;
2. 10 CFR 50.55a, as it relates to the requirements for testing and inspecting Code Class 1 components of the RCPB as specified in ASME Section XI;
3. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations;
4. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC’s regulations identified above are set forth below. The DSRS is not a substitute for the NRC’s regulations, and compliance with it is not required. As an alternative, and as described in more detail below, an applicant may identify the differences between a DSRS section and the design features (DC and COL applications only), analytical techniques, and procedural measures

proposed in an application and discuss how the proposed alternative provides an acceptable method of complying with the NRC regulations that underlie the DSRS acceptance criteria.

1. System Boundary Subject to Inspection. The applicant's or licensee's definition of the RCPB is acceptable if it is in agreement with the following criteria: the inspection requirements of 10 CFR 50.55a, as detailed in ASME Section XI, must be met for all Class 1 pressure-containing components (and their supports). The system boundary, as defined in 10 CFR 50.2, includes all pressure vessels, piping, pumps, and valves which are part of the reactor coolant system, or connected to the reactor coolant system, up to and including:
 - A. The outermost containment isolation valve in system piping that penetrates the primary reactor containment.
 - B. The second of two valves normally closed during normal reactor operation in system piping that does not penetrate primary reactor containment.
 - C. The reactor coolant system safety and relief valves.
2. Accessibility. The design and arrangement of system components are acceptable if adequate clearance is provided in accordance with Subarticle IWA-1500, "Accessibility," of ASME Section XI.
3. Examination Categories and Methods. The examination categories and methods specified in the SAR are acceptable if they are in agreement with the criteria in Article IWB-2000, "Examination and Inspection," of ASME Section XI. Every area subject to examination should fall within one or more of the examination categories in ASME Section XI, Article IWB-2000, and should be examined at least to the extent specified. The methods of examination for the components and parts of the pressure retaining boundaries are also listed in the requirements of Article IWB-2000 of ASME Section XI.

The applicant's or licensee's examination techniques and procedures used for preservice examination or inservice inspection of the system are acceptable if they are in agreement with the following criteria:

- A. The methods, techniques, and procedures for visual, surface, or volumetric examination are in accordance with ASME Section XI, Article IWA-2000, "Examination and Inspection," and ASME Section XI, Article IWB-2000, "Examination and Inspection," of ASME Section XI.
- B. The acceptance standards for the examination results required by 3.A above are given in ASME Section XI, Article IWB-3000, "Acceptance Standards."
- C. The methods, procedures, and requirements for qualification of personnel performing ultrasonic examination are in accordance with the requirements of Appendix VII to ASME Section XI, Division 1.

- D. Performance demonstration for ultrasonic examination procedures, equipment, and personnel used to detect and size flaws is in accordance with the requirements of ASME Section XI, Appendix VIII.
 - E. The methods, procedures, and requirements for ultrasonic examination of reactor-vessel-to-flange welds, closure-head-to-flange welds, and integral attachment welds incorporate the requirements of ASME Section XI, Appendix VIII.
4. Inspection Intervals. The required examinations and pressure tests must be completed during each ten-year interval of service, hereinafter designated as the inspection interval. In addition, the scheduling of the program must comply with the provisions of Article IWA-2000, "Examination and Inspection," concerning inspection intervals of ASME Section XI.
5. Evaluation of Examination Results
- A. The standards for evaluation of examination results are acceptable if they are in accordance with the requirements of ASME Section XI, Article IWB-3000, "Acceptance Standards."
 - B. The proposed program regarding repair or replacement of components containing defects is acceptable if the program is in accordance with the requirements of ASME Section XI, Article IWA-4000, "Repair/Replacement Activities." The criteria that establish the need for repair or replacement are described in ASME Section XI, Article IWB-3000, "Acceptance Standards."
 - C. The standards for evaluation of examination results should be in accordance with the requirements of ASME Section XI, Article IWB-3000, "Acceptance Standards."
6. System Pressure Tests. The pressure-retaining Code Class 1 component leakage and hydrostatic pressure test program is acceptable if the program is in accordance with the requirements of ASME Section XI, Article IWB-5000, "System Pressure Tests," and the technical specification requirements for operating limitations during heatup, cooldown, and system hydrostatic pressure testing. In some cases, these limitations may be more severe than those in ASME Section XI, Article IWB-5000.
7. Code Exemptions. Exemptions from ASME Code examinations should be permitted if the criteria in ASME Section XI, Subsubarticle IWB-1220, "Components Exempt from Examination," are met. The applicant's or licensee's program should list the exemptions taken in accordance with the ASME Code.
8. Relief Requests. At the DC or COL application stage, there should be no requests for relief from the ASME Section XI examination requirements that are found to be impractical due to the limitations of design, geometry, or materials of construction of components that are evaluated in accordance with 10 CFR 50.55a. Interferences due to design, geometry and materials of construction must be eliminated during the design

stages to enable the performance of PSI/ISI examinations in accordance with the regulations.

9. Code Cases. ASME code cases referenced by the COL application are reviewed for acceptability and compliance with RG 1.147. Code cases not specifically referenced in RG 1.147 will be reviewed and accepted on a case-by-case basis.
10. Augmented ISI to Protect Against Postulated Piping Failures. The reviewer verifies that the high-energy system piping between containment isolation valves should receive an augmented ISI as follows:
 - A. Protective measures, pipe whip restraints, structures, supports and guard pipes should not prevent access required to conduct the inservice examinations specified in the ASME Section XI, Division 1.
 - B. For those portions of high-energy fluid system piping between containment isolation valves, the inservice examination completed during each inspection interval should provide 100% volumetric examination of circumferential and longitudinal pipe welds.
 - C. For those portions of high-energy fluid system piping enclosed in guard pipes, inspection ports should be provided in the guard pipes to permit the required examination of circumferential pipe welds. Inspection ports should not be located in the portion of the guard pipe passing through the annulus of dual-barrier containment structures.
 - D. The areas subject to examination should be defined in accordance with the Examination Category for Class 1 piping welds specified in ASME Section XI, Article IWB-2000.
11. Other Inspection Programs
 - A. For PWR plants, the reviewer verifies that the applicant or licensee has established a program to detect and correct potential RCPB corrosion caused by boric acid leaks, as described in Generic Letter 88-05.
12. Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestone(s) for the Preservice Inspection, ISI and Inservice Testing Programs are reviewed in accordance with 10 CFR 50.55a(g) and 10 CFR Part 50, Appendix A.
13. ITAAC. 10 CFR 52.47(b)(1) requires that a DC application contain proposed ITAAC necessary and sufficient to assure the plant is built and will operate in accordance with the design certification. 10 CFR 52.97(b) requires that the COL identify the ITAAC necessary and sufficient to assure that the facility has been constructed and will be operated in conformity with the license. SRP Section 14.3 provides guidance for reviewing the ITAAC. The requirements of 10 CFR 52.47(b)(1) and 10 CFR 52.97(b) will be met, in part, by identifying ITAAC of the top-level design features of the RCPB

inservice testing and inspection to ensure compliance with 10 CFR 50.55a in the DC and COL applications, respectively.

14. Risk Informed ISI Program. When submitting a risk informed ISI program, the applicant or licensee should provide all information necessary to meet the other DSRS acceptance criteria in this SRP, including:
- A. System boundary subject to inspection
 - B. Accessibility
 - C. Examination Categories and Methods
 - D. Inspection Intervals
 - E. Evaluation of Examination Results
 - F. System Pressure Tests
 - G. Code Exemptions
 - H. Relief Requests
 - I. Code Cases
 - J. Augmented ISI
 - K. Proposed Implementation Milestones

As an alternative to the requirements of 50.55a, a risk-informed ISI program is acceptable if it clearly demonstrates one of the following:

- A. That the proposed alternative provides an acceptable level of quality and safety in comparison to the current requirements.
- B. Compliance with the current regulations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Therefore, when describing each ISI program area, the applicant should include the following information for each case in which the program requirements are proposed as an alternative to the requirements of 10 CFR 50.55a or ASME Section XI:

- A. The requirement(s) for which the alternative is requested
- B. The proposed alternative(s)
- C. The basis for seeking authorization of the alternative

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this DSRS section is discussed in the following paragraphs:

1. General Design Criterion 32 requires, in part, that all components that are part of the RCPB be designed to permit periodic inspection and testing of important areas and features to assess structural and leak-tight integrity. DSRS Section 5.2.4 is the primary DSRS section assessing compliance with GDC 32. Meeting the requirements of General Design Criterion 32 assures that an effective periodic inspection program can be performed on the RCPB, so that aging effects or other incipient degradation phenomena may be identified and preventive measures promptly taken to preclude potential loss of reactor coolant or impairment of reactor core cooling.

2. According to 10 CFR 50.55a, "Codes and Standards," structures, systems, and components (SSCs) must be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function they are intended to perform. Section 50.55a incorporates by reference Section XI of the ASME Boiler and Pressure Vessel Code. ASME Section XI defines, for each Code Class, the intervals between inservice inspections, the scope of the inspection activity, the inspection sample, the sample selection methodology, the method of inspection, the acceptance criteria for various types and sizes of material flaws identified during the inspection, and various other related technical details required for properly performing the inservice inspection activity. Performing a periodic inspection program based on the requirements of 10 CFR 50.55a and ASME Section XI is the means of maintaining the structural integrity of the RCPB at a level of reliability comparable to that at which it was initially installed and of ensuring the structural and leak-tight integrity of the RCPB.

III. REVIEW PROCEDURES

These review procedures are based on the identified DSRS acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. Selected Programs and Guidance—In accordance with the guidance in NUREG-0800, "Introduction – Part 2: Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: Light-Water Small Modular Reactor Edition" (NUREG-0800, Intro Part 2), as applied to this DSRS Section, the staff will review the information proposed by the applicant to evaluate whether it meets the acceptance criteria described in Subsection II of this DSRS. As noted in NUREG-0800, Intro Part 2, the NRC requirements that must be met by an SSC do not change under the small modular reactor (SMR) framework. Using the graded approach described in NUREG-0800, Intro Part 2, the NRC staff may determine that, for certain SSCs, the applicant's basis for compliance with other selected NRC requirements may help demonstrate satisfaction of the applicable acceptance criteria for that SSC in lieu of detailed independent analyses. The design-basis capabilities of specific SSCs would be verified, where applicable, as part of completing the applicable ITAAC. The use of the selected programs to augment or replace traditional review procedures is shown in Figure 1 of NUREG-0800, Intro Part 2. Examples of such programs that may be relevant to the graded approach for these SSCs include:
 - 10 CFR Part 50, Appendix A, GDC, Overall Requirements, Criteria 1–5
 - 10 CFR Part 50, Appendix B, Quality Assurance (QA) Program
 - 10 CFR 50.49, Environmental Qualification of Electrical Equipment (EQ) Program
 - 10 CFR 50.55a, Code Design, Inservice Inspection, and Inservice Testing (ISI/IST) Programs

- 10 CFR 50.65, Maintenance Rule requirements
- Reliability Assurance Program (RAP)
- 10 CFR 50.36, “Technical Specifications”
- Availability Controls for SSCs Subject to Regulatory Treatment of Nonsafety Systems (RTNSS)
- Initial Test Program (ITP)
- Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)

This list of examples is not intended to be all inclusive. It is the responsibility of the technical reviewers to determine whether the information in the application, including the degree to which the applicant seeks to rely on such selected programs and guidance, demonstrates that all acceptance criteria have been met to support the safety finding for a particular SSC.

2. In accordance with 10 CFR 52.47(a)(8), (21), and (22), and 10 CFR 52.79(a)(17), (20), and (37), for DC or COL applications submitted under 10 CFR Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues which are identified in the version of NUREG-0933, “Resolution of Generic Safety Issues,” current on the date up to 6 months before the docket date of the application and which are technically relevant to the design, (2) demonstrate how the operating experience insights have been incorporated into the plant design, and (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v), for a DC application, and except paragraphs (f)(1)(xii), (f)(2)(ix), (f)(2)(xxv), and (f)(3)(v), for a COL application. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.
3. System Boundary Subject to Inspection. The information furnished in the SAR is reviewed for agreement with the DSRS Acceptance Criteria in Subsection II.1 of this DSRS section and to verify that any differences between the applicant's or licensee's definition of the RCPB and Subsection II.1 are identified and justified; e.g., “There are no longitudinal welds in beltline region as vessel is constructed of forged rings.”
4. Accessibility. The descriptive information concerning accessibility furnished in the SAR is reviewed for compliance with the DSRS Acceptance Criteria in Subsection II.2 of this DSRS section. The reviewer verifies that the clearances supplied for general access to the system components listed in ASME Section XI, Article IWB-2000, “Examination and Inspection,” are adequate.

The reviewer verifies that adequate provisions are made for remote inspection of those components affected by radiation fields after plant startup. These components include

the beltline welds and reactor vessel nozzle interior surfaces. The reviewer verifies that remote inspection devices proposed for periodic inservice inspections will be used for the preservice baseline inspection program to demonstrate feasibility.

5. Examination Categories and Methods. The reviewer verifies that the examination techniques described by the applicant or licensee are the same as those in the DSRS Acceptance Criteria in Subsection II.3 of this DSRS section. If alternative examination methods are proposed, they are reviewed to verify that the results are equivalent or superior to those in Subarticles IWA-2200, "Examination Methods," and IWB-2200, "Preservice Examination," of Section XI, and that the acceptance standards of ASME Section XI, Article IWB-3000, "Acceptance Standards," are met.

The reviewer verifies that the personnel qualification and requalification portion of the ISI program is in conformance with applicable portions of ASME Section XI. Additionally, qualification of personnel performing ultrasonic examinations should comply with the requirements of ASME Section XI, Appendix VII, "Qualification of Nondestructive Examination Personnel for Ultrasonic Examination".

The reviewer ascertains, with respect to ultrasonic examination systems, that the ISI program complies with the requirements of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," to ASME Section XI, Division 1 in accordance with the implementation requirements of 10 CFR 50.55a.

6. Inspection Intervals. The Technical Specification program for inservice inspection is reviewed to establish that the inspection schedule for every area and component in the program is in agreement with the DSRS Acceptance Criteria in Subsection II.4 of this DSRS section.
7. Evaluation of Examination Results. The criteria statements provided by the applicant or licensee are reviewed for agreement with Subsection II.5 of this DSRS section as follows:
 - A. The reviewer verifies that the applicant's or licensee's criteria comply with Article IWB-3000, "Acceptance Standards," of ASME Section XI regarding standards for examination evaluation.
 - B. The reviewer verifies that the applicant's or licensee's criteria comply with Article IWA-4000, "Repair/Replacement Activities," of ASME Section XI regarding repair procedures.
8. System Pressure Test. The reviewer determines that the Technical Specification on pressure testing of the RCPB adheres to the DSRS Acceptance Criteria in Subsection II.6 of this DSRS section. The Technical Specification on operating limitations during heatup, cooldown, and system pressure testing should be referenced.
9. Code Exemptions. The reviewer verifies that the exemptions from ASME Code examinations are in accordance with the requirements of ASME Section XI, Subsubarticle IWB-1220, "Components Exempt from Examination."

10. Relief Requests. There should not be a need for the DC applicant to request relief from an ASME Section XI requirement based on limitations of the design, geometry, or materials of construction because any deficiencies should be addressed during the design stages. 10 CFR 50.55a requires that Class 1 components (including their supports) shall be designed and provided with access to perform preservice and inservice examinations in accordance with the ASME Code.
11. Code Cases. The ISI program code cases are reviewed to determine that the code cases are approved by the NRC and included in RG 1.147, Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1. Code cases not specifically referenced in RG 1.147 are reviewed and accepted on a case-by-case basis.
12. Augmented ISI to Protect Against Postulated Piping Failures. The ISI Program is reviewed to verify that the inspection attributes of the program are in agreement with the DSRS Acceptance Criteria in Subsection II.9 of this DSRS section for high-energy fluid system piping between containment isolation valves.
13. Operational Programs. The reviewer verifies that the Preservice Inspection, Inservice Inspection and Inservice Testing Programs are fully described and that implementation milestones have been identified. The reviewer verifies that the program and implementation milestones are included in FSAR Table [13.4-x].

Implementation of ISI program will be verified by reviewing the program in accordance with NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections."
14. Risk informed ISI. The ISI program reviewer verifies that the applicant's (or licensee's) technical submittal describes a risk-informed ISI program that meets the acceptance criteria identified in Subsection II.13 of the DSRS Acceptance Criteria in this DSRS section. The PRA reviewer verifies the suitability of the probabilistic risk analyses and that risk insights have been appropriately implemented.

For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's technical review and analysis, as augmented by the application of programmatic requirements in accordance with the staff's technical review approach in the DSRS Introduction, support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

To ensure that no deleterious defects develop during service, selected welds and weld heat-affected zones will be inspected prior to plant startup and periodically throughout the life of the plant. The applicant (or licensee) has stated that the inservice inspection (ISI) program will comply (complies) with the rules published in 10 CFR 50.55a. The design of the reactor coolant system incorporates provisions for access for inservice inspection in accordance with Section XI of the ASME Boiler and Pressure Vessel Code, (xx) Edition, including Addenda through the (xx) Addenda. Suitable equipment will be (has been) developed and installed to facilitate the remote inspection of these areas of the reactor coolant pressure boundary that are not readily accessible to inspection personnel. The ISI program will consist of a preservice examination plan and an inservice inspection plan. The conduct of periodic inspections and pressure testing of pressure-retaining components of the reactor coolant pressure boundary in accordance with the requirements in applicable subsections of ASME Section XI provides reasonable assurance that evidence of structural degradation or loss of leak-tight integrity occurring during service will be detected in time to permit corrective action before the safety function of a component is compromised. Compliance with the inservice inspections required by this Code constitutes an acceptable basis for satisfying in part the requirements of GDC 32.

The staff concludes that the inservice program is acceptable and meets the inspection and testing requirements of General Design Criterion 32 and 10 CFR 50.55a. This conclusion is based on the applicant's or licensees meeting the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," as reviewed by the staff and determined to be appropriate for this application.

Within 12 months after COL issuance, the licensee shall submit to the NRC an implementation schedule for the Reactor Coolant Pressure Boundary Preservice Inspection, Inservice Inspection and Inservice Testing Program listed in FSAR Table [13.x]. The schedule shall be updated every 6 months until 12 months before scheduled fuel load and monthly thereafter until either the last program in FSAR Table [13.x] has been fully implemented or the plant has been placed into commercial service, whichever comes first.

The applicant described the ISI and Inservice Testing Programs and their implementation in conformance with 10 CFR 50.55a(g) and 10 CFR Part 50, Appendix A.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this DSRS section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The regulations in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41) establish requirements for applications for ESPs, DCs, and COLs, respectively. These regulations require the application to include an evaluation of the site (ESP), standard plant design (DC), or facility (COL) against the SRP revision in effect 6 months before the docket date of the application. While the SRP provides generic guidance, the staff developed the SRP guidance based on the staff's experience in reviewing applications for construction permits and operating licenses for large light-water nuclear power reactors. The proposed SMR designs, however, differ significantly from large light-water nuclear power plant designs.

In view of the differences between the designs of SMRs and the designs of large light-water power reactors, the Commission issued Staff Requirements Memorandum (SRM)-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights To Enhance Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010. In the SRM, the Commission directed the staff to develop risk-informed licensing review plans for each of the SMR design reviews, including plans for the associated preapplication activities. Accordingly, the staff has developed the content of the DSRS as an alternative method for evaluating a NuScale-specific application submitted pursuant to 10 CFR Part 52, and the staff has determined that each application may address the DSRS in lieu of addressing the SRP, with specified exceptions. These exceptions include particular review areas in which the DSRS directs reviewers to consult the SRP and others in which the SRP is used for the review. If an applicant chooses to address the DSRS, the application should identify and describe all differences between the design features (DC and COL applications only), analytical techniques, and procedural measures proposed in an application and the guidance of the applicable DSRS section (or SRP section, as specified in the DSRS), and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria.

The staff has accepted the content of the DSRS as an alternative method for evaluating whether an application complies with NRC regulations for NuScale SMR applications, provided that the application does not deviate significantly from the design and siting assumptions made by the NRC staff while preparing the DSRS. If the design or siting assumptions in a NuScale application deviate significantly from the design and siting assumptions the staff used in preparing the DSRS, the staff will use the more general guidance in the SRP, as specified in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), or 10 CFR 52.79(a)(41), depending on the type of application. Alternatively, the staff may supplement the DSRS section by adding appropriate criteria to address new design or siting assumptions.

REFERENCES

1. 10 CFR 50.55a, "Codes and Standards."
2. 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records."

3. 10 CFR Part 50, Appendix A, General Design Criterion 32, "Inspection of Reactor Coolant Pressure Boundary."
4. NRC letter to all licensees of operating PWRs and holders of construction permits for PWRs, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants (Generic Letter No. 88-05)," March 17, 1988.
5. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Facility Components," Subsection NCA, "General Requirements for Division 1 and Division 2," and Division 1, Subsection NB, "Class 1 Components," American Society of Mechanical Engineers.
6. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Division 1, "Rules for Inspection and Testing of Components of Light-Water Cooled Plants," American Society of Mechanical Engineers.
7. SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria."
8. NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Inspection of Construction and Operational Programs," issued September 15, 2009.